



## Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact [support@jstor.org](mailto:support@jstor.org).

XV.—*Barometric and Thermometric Measurements of Heights in North America.* By Captain J. H. Lefroy, Royal Artillery, Director of the Magnetic Observatory at Toronto.

THE observations described in the following pages were made during the execution of a Magnetical Survey of parts of the interior of North America. As this object required that the author should travel extensively throughout Canada, and the territory of the Hon. Hudson's Bay Company, it appeared desirable that he should combine barometric and other observations with it, when practicable. For this purpose he was provided with two of Newman's portable barometers with iron cisterns, which were carefully compared with the standard barometer of the observatory at Toronto before leaving it. The following table contains the results of the comparison, together with the constants given by the maker :—

Barom. 119. Neutral Point 28·816	Barom. 33. Neutral Point 29·922
Capacity . $\frac{1}{38}$	Capacity . $\frac{1}{38}$
Capillarity + 0·046	Capillarity + 0·046
Temperature . 60°	Temperature . 68°
Comparison — 0·063	Comparison — 0·036

And these data have been used in correcting all the observed readings of the instruments.

The principal series to be described commenced in April 1843 ; but some observations had been previously made at Bond Lake, a small body of water near the height of land between Lake Ontario and Lake Huron. At Lake Simcoe and at Lake Huron, the data are given below, the results were—

1.—2 July, 1841. Lake Simcoe above Lake Ontario, by observations at Holland Landing, made by Lieut. Younghusband . . . . .	Ft. 498
2.—24 Jan. 1843. Lake Simcoe, above Lake Ontario, by observations at Barrier, made by Lieut. Lefroy, R.A. . . . .	497
3.—23 Jan. 1843. Bond Lake above Lake Ontario . . . . .	783
4.—26 Jan. 1843. Lake Huron above Lake Ontario, by observations at Penetanguisheue . . . . .	365

TABLE II.

Date.	Upper Station.	Station.		Toronto.		Diff. of Level.	Redn. to the Water Level.	Above Lake Ontario.
		Corrd. Barom.	Air.	Corrd. Barom.	Air.			
2 July, 1841 .	Holland Landing, Lake Simcoe.	Inches. 29·396	69	Inches. 29·828	68	Feet. 412	Feet. 22	Feet. 498
* Jan. 1843. .	Barrier on ditto . . . . .	28·870	28	29·328	29	409	20	497
23 Jan. „	Bond Lake . . . . .	28·220	33	29·129	35	833	50	783
26 Jan. „	Penetanguisheue . . . . .	29·540	20	29·842	17	258	1	365

The cistern of the barometer in the Observatory at Toronto is 108 feet above the mean level of Lake Ontario ; the level of the lake itself varies about 5 feet in different years.

\* This date in the MS. could not be made out.—ED.

## ABSTRACT OF BAROMETRIC OBSERVATIONS made on the Route to Lake LA PLUIE.

All Observations reduced to a temperature of 32°.

STATION.	DATE.		Barometer.			Barometer Corrected Reduced.	At Toronto.		Elevation above		Barometer.	Correction.
	May, 1843.		Observed.	Merc.	Air.		Barometer.	Air.	Toronto.	The Sea.		
Nr. R. la Graise, on the Ottawa	H. M.			°				°	—	+	+	
	2 6 0 P.M.		30.200	44.3	..	30.183	29.901	51.7			119	
	7 0		.201	42.7	..	.186	.912	45.3			,,	
Pte. aux Chenes	8 0		.242	41.7	..	.238	.906	43.8			,,	
					42.9	30.202	29.906	46.9	—	77		
Fox's Point ...	3 8 0 P.M.		30.154	52.4	48.5	30.114	29.853	42.4			,,	
	0 5		.150	52.2	,,	.111	.853	42.4			,,	
	0 50		.140	51.2	48.0	.101	29.863	42.5			,,	
Pte. aux Sieoux					48.3	30.109	29.856	42.4	—	115		
	4 2 45 P.M.		30.150	64.0	55.2	30.079	29.926	46.0	—	141	,,	
Aylmer . . .	8 0 P.M.		30.240	42.6	38.3	30.226	29.968	39.3	—	114	,,	
	1 48 P.M.		30.240	52.2	49.2	30.212	30.006	39.9			,,	
	2 48		.238	51.2	49.0	.203	29.984	41.6			,,	
	9 0		.204	36.2	36.1	.204	.902	42.4			119	
	6 4 27 A.M.		29.704	45.0	43.0	.674	.757	40.5			33	
	,,		.706	45.2	,,	.680	,,					
						30.069	29.912	41.0	—	201		

The village of Aylmer is about 12 m. above Bytown, and above the Chaudière Falls. The Ottawa at Bytown is 120 feet below L. Ontario, by the levels of the Rideau Canal, or 228 below the Observatory. If we allow 40 feet for the difference of level between the Ottawa at Aylmer and the same river below the Chaudière rapids and falls, the Barometric result will differ 47 feet from the result by levelling.

7	Bonne Chère . . .	4 30 A.M.	29.652 .653	43.6 43.7	40.9	29.630 .637	29.450	53.4	—	168	174	119 33
	12 m. above the Gr. Calumet.	10 30 P.M.	29.442 .442	48.3 48.3	47.3	29.414 .401	29.388	62.6	—	20	322	119 33
8	Fort Coulogne .	9 0 A.M.	29.500 .488	53.4 55.0	46.8	29.436 .432	29.532 ,,	49.6				119 33
		10 0	.482	56.3	47.3	.420	.536	52.2				119 33
		11 0	.480	55.8	49.2	.421	,,	53.4				119 33
			.510 .490	51.0 51.5		.490 .454	.538 ,,					119 33
	Chiapeau Island	9 20 P.M.	29.602 .580	46.0 45.7	44.0	29.567 .550	29.646 .658	43.9 42.5	85	427		119 33
		10 1 0 P.M.	29.970	77.8	74.3	29.758	29.846	55.8	84	426		119
11	Roche Capitaine	9 0 A.M.	29.790	53.0	54.3	29.747	29.846	54.6	92	434		
		3 0 P.M.	29.690	78.5	78.7	29.573	29.767	61.7	186	528		
		9 0 P.M.	29.672	50.3	49.0	29.627	29.751	48.9				
		10 0	.644	46.0	45.3	.610	.744	47.3				
12	Marawoon . . .	8 0 A.M.	29.632	52.0	50.3	29.582	29.762	60.7				
		9 0	.632	58.3	57.3	.569	.750	56.4				
		noon	.551	70.3	69.7	.454	.700	62.1				
					59.1	29.535	29.737	63.1	190	532		

Abstract of Barometric Observations—continued.

STATION.	DATE. May, 1843.	Barometer.			Barometer Corrected and Reduced.	At Toronto.		Elevation above Toronto, The Sea.		Baromet.	Correction.
		Observed.	Merc.	Air.		Barometer.	Air.	Toronto.	The Sea.		
The Little River	12 H. M. 8 0 P.M.	29.368	60.0	58.0	29.292	29.548	55.4	+	+	119	
		.325	55.4	54.5	.261	.534	53.5			"	
		.246	50.8	50.0	.192	.485	49.5			"	
Pte. de Talon	13 7 30 A.M.				29.248	29.522	52.8	236	578		
		29.202	58.0	56.0	29.135	29.504	53.3	347	689	"	6
L. de Grand Vase	2 0 P.M. 3 0	29.235	66.8	62.7	29.150	29.439	71.2			"	
		.194	67.6	68.3	.096	.430	70.5			"	
P. de Gr. Vase, 1st.	14 8 0 P.M. 9 0 4 0 A.M.			65.5	29.123	29.434	70.8	301	643		10
		29.184	53.6	52.9	29.123	29.455	63.9			"	
		.182	53.0	51.4	.122	.456	59.0			"	
		.200	36.8	36.0						"	
2nd Postage . .	8 30 A.M.			52.1	29.122	29.455	61.4	314	658		
		29.274	65.0	65.0	29.183	29.488	60.4	296	647	119	
L. Nipissing . .	3 0 P.M.	29.125	65.8	65.1	29.029	29.390	70.6	353	69.5	119	
		.112	65.8		.028					33	
L. Nipissing . .	8 0 P.M. 9 0 P.M.	29.012	72.0	73.2						119	
		28.904	72.2	73.2						33	
		29.000	73.0	73.2						119	
		28.902	73.1							33	

None at Toronto.

Mean of readings taken  
every 5 m. from 2.30 to  
3.30.

None at Toronto.

Chaudière P. . .	15	4 0 A.M.	28.908	63.0	63.2	28.818	29.275	53.7	440	782	119	
		9 0 A.M.	28.978	73.3	73.5	28.864	29.215	65.4	340	682	,,	10
Riccollet Falls .		4 0 P.M.	28.906	54.6	54.8	28.838	29.120	79.9	275	617	,,	
Lake Huron . .	16	1 0 P.M.	29.300	45.2	44.5	29.260	29.475	64.6			119	
			.292	45.2		.259					33	
		2 0	.314	45.0	44.2	.276	.475	65.7			119	
			.306	45.0		.274					33	
		3 0	.350	43.6	43.5	.315	.481	67.0			119	
			.342	43.6		.312					33	
		4 0	.350	44.4	45.0	.314	.500	67.5			119	
			.340	44.4		.311					33	
		5 0	.362	45.2	45.4	.324	.534	66.9			119	
			.358	45.0		.328					33	
		6 0	.442	45.8	46.0	.404	.567	64.7			119	
			.434	45.6		.403					33	
L. Huron . . .	17	8 0 A.M.	29.640	50.2	48.3	29.596	29.837	43.6	219	561	119	6
		2 0 P.M.	29.630	50.2	48.3	29.584	29.824	56.4	220	562		
L. Huron . . .	18	9 0 A.M.	29.750	45.0	42.6	29.721	29.964	48.0	220	562		
		3 0 P.M.	9.723	60.5	59.8	29.644	29.891	59.9				
		3 30	.711	58.2	57.0	.647	.891					
St. Mary's r. . .	19	10 0 P.M.	29.618	35.6	33.2	29.594	29.855	41.7				
		10 5	.620	,,	,,	.606	,,					
		3 0 A.M.	.654	34.2	30.0	.633	29.844	41.0				
					31.6	29.616	29.850	41.3	208	550		5

Abstract of Barometric Observations—continued.

STATION.	DATE. May, 1843.	Barometer.			Barometer Corrected and Reduced.	At Toronto.		Elevation above Toronto. The Sea.		Baromet.	Correction.
		Observed.	Merc.	Air.		Barometer.	Air.	Toronto.	The Sea.		
Lake Superior.	19	H. M. 8 0 A.M. 8 30	29.664 .680	53.0 53.0	49.8 50.4	29.602 .628	29.852 53.0	218	560	119	6
		2 0 P.M. 3 0	29.628 .626	65.2 63.4	53.8 53.0	29.532 .535	29.789 .773				
					53.4	29.534	29.781 61.6	230	572		
		9 0 10 0 3 30 A.M.	29.504 .502 .506	52.8 52.6 40.2	40.4 40.8 39.0	29.448 .446 .455	29.725 .709 .683				
,,	20				40.1	29.450	29.706 40.0	231	573		5
		4 0 A.M.	29.052	49.0	48.6	28.998	..	..	..	..	..
		8 0 8 30	29.064 .060	53.6 54.0	53.0 53.0	28.990 .995	29.408 54.0	386	728		10
		3 30	28.974	70.0	68.0	28.866	29.261 70.6	385	727		15
,,	22	5 0	28.976	68.0	66.2	28.874	..	..	..	..	..
		midnight 4 0 A.M.	28.856 .854	46.3 42.2	45.2 38.9	28.806 .814	29.231 222				
					42.0	28.810	29.227 47.2	387	729		20
		8 0 A.M. 8 30	28.850 .850	45.0 45.4	40.6 40.6	28.802 .802	29.241 54.4	409	751		3

None at Toronto.

None at Toronto.

Michigan	8 0 P.M.	28.844	46.4	42.0	28.811	29.204	50.5	..	..	..
23	9 0	.846	45.0	40.0	.827	.206	50.3			
	10 0	.852	44.8	40.2	.824	.204	50.8			
	5 0 A.M.	.980	37.8	37.2	.969	.209	48.0			
	6 0	.852	38.0	37.4	.961	.226	50.0			
	7 0	.29.000	43.4	39.0	.986	.233	53.4			
24	8 0	.006	45.6	44.4	.971	.229	54.6			
				40.2	28.907	29.216	51.1	287	629	10
	8 0 A.M.	29.346	45.2	44.2	29.317	29.511	50.8	173	515	8
	8 30	.314	45.6	44.2	.315					
	9 0 P.M.	29.202	50.0	43.2	29.171	29.556	51.3			
25	10 0	.204	53.0	44.0	.173	.556	49.8			
	3 30 A.M.	.178	44.6	44.0	.127	.591	44.7			
				43.7	29.154	29.568	48.6	380	722	10
	8 0 A.M.	29.218	50.0	51.8	29.167	29.626	51.2			
	9 0	.222	51.0	52.0	.171	.624	53.0			
26	9 30	.220	52.0	52.4	.171	.624	53.0			
	11 0	.192	53.0	54.4	.126	.639	53.6			
				52.6	29.159	29.631	53.2	439	781	40
	7 0 P.M.	29.136	53.0	53.6	29.080	29.566	54.2			
	8 0	.134	52.8	54.0	.078	.560	52.2			
L. Superior	9 0	.134	53.2	55.0	.075	.542	51.5			
	4 30 A.M.	.024	49.2	48.0	28.970	.477	50.4			
	5 0	.024	49.0	48.0	.970	.471	49.4			
	6 0	.000	49.6	48.8	.940	.461	49.6			
				51.2	29.019	29.513	51.2	461	803	6

The woodwork of the Barometer became swollen to such a degree after a night in which it was exposed to the wet, that the brass guard at the cistern-end was burst, and the shade at the other end became immovable, no observations were made until June 2nd.



Barometric Observations—continued.—All with No. 119.

STATION.	DATE. June, 1843.	Barometer.			Barometer Corrected and Reduced.	At Toronto.		Elevation above		Correction.
		Observed.	Merc.	Air.		Barometer.	Air.	Toronto.	The Sea.	
Foot of the Mountain Portage.	H. M.									
	2 10 30 A.M.	29.186	43.8	42.8	29.154	29.716	48.2	..	..	..
	33	.194	43.8		.162					
	36	.191	43.4		.159					
	39	.192	43.0		.160					
At the Port Ecarterre, immediately above the preceding.	42	.200	43.0	42.0	.171					
				42.4	29.161	29.716	48.2	509	851	
	11 46	29.084	46.0	46.0	29.045	29.662	50.4			
	49	.084	46.0		.045					
	53	.088	45.5		.050					
Bad Port . . .	56	.083	45.5		.045					
	59	.080	45.0		.041					
	12 5	.080	44.5	43.0	.039					
				44.5	29.034	29.662	50.4	580	922	
	9 30 P.M.	28.981	32.	32.0	28.967	29.403	40.9			
Décharge of the large flag-stones	35	.984			.970	.403				
	40	.964			.951	.403				
	3 10 A.M.	.953	28.	28.	.954	.245	43.2			
					28.960	29.363	42.0	365	707	12
	1 50 P.M.	28.860	54.		28.809	29.502	51.8			
	55	.855	54.		.804					
	2 0	.858	54.		.807					
			54.		28.807	29.502	51.8	653	995	6

Referring the observations at the upper station, above the great Falls of Kakabeka, to those at their foot, or the lower station, the difference of altitude is only 117 feet. The reputed height of these Falls is ———?\*

\* The magnificent Fall of Kakabeka is described and a view of it given in Major Long's "Narrative of an Expedition to St. Peter's River, &c." in which work the height of the fall is said to be 136 feet.—Ed.

Portage de Chien, lower end.	5 30 P.M. 45 6 0 15	28-770 .766 .762 .756	48-0 49-0 46-0 46-0		28-721 .714 .708 .702	29-553 29-539 50-9	51-7	..	..	..	..	..
Top of the Hill .	7 7 12 15 17 20 45	28-300 .292 .296 .291 .290 .282	47-2 46-0 45-5 45-2 45-0 45-0 43-0		28-711 28-250 .243 .247 .242 .241 .231	29-546 29-547 49-1	51-3 49-1	779	1121	4		
Upper end of the Portage . . .	10 10 15	28-356 .348	30-0 30-0		28-242 28-344 .336	29-517 29-523	49-1 47-2	1221	1563		1417	
Chien Lake . .	4 30 A.M. 35 5 0 15 30	.352 .354 .359 .356 .365	40-5 41-0 42-0 41-0 41-0	..	..	..	..	..	..	..	..	..
R. de Chien . .	8 40 9 10 30	28-416 .412 .419	51- 52- 52-	59- 59- 59-	29-353 .347 .354	29-282 44-0	44-0	883	1225	6		
	4 9 15 P.M. 25 35	28-522 .536 .524	46-4 48-5 48-5	45-8 45-0 45-0	28-473 .482 .470	..	..	..	..	..	..	..

Referring the observations on the top of the hill to those at the lower end of the portage, we have 445 feet for the height of the hill in this portage, and 364 feet for the height of the upper end, or Chien Lake.—On reversing the barometer in the dark this evening, a great deal of electrical light was noticed in the vacuum.

Sunday at Toronto.

None at Toronto.

Barometric Observations—continued. All with No. 119.

STATION.	DATE. June, 1943.	Barometer.			Barometer Corrected and Reduced.	At Toronto.		Elevation above The Sea.		Correction.
		Observed.	Merc.	Air.		Barometer.	Air.	Toronto.	The Sea.	
R. de Chien . .	H. M. 3 15 A.M. 30	28.565 .578	41.5 42.0	41.7	28.530 .542	29.426	47.8	827	1169	
	8 10 30 35	28.685 .681 .688	46.5 47.0 48.0		28.629 .625 .629	29.451 .461	48.0 49.0			
Jordan's Pge. .			47.2		28.628	29.456	48.5	773	1115	
	2 45 P.M. 50 55	28.642 .638 .636	56.0 55.6 55.4	53.0	28.572 .569 .567	29.470	50.6			
Lower end of the Prairie Portage.	3 0 5 10	.634 .634 .634	55.0 55.0 55.0		.566 .566 .566					
			55.3	53.	28.568	29.470	50.6	1852	1194	
Middle of do. .	3 55 4 0 3 5	28.450 .444 .444	56.4 56.2 56.0		28.389 .383 .383	29.464	49.6	..	..	..
	10 15 20	.444 .444 .442	56.0 56.0 55.9		.382 .382 .380					
			56.1		28.383	29.464	49.6	1025	1367	

Referring the observations at the upper end of this portage to those taken at the lower end, the difference of elevation is 164 feet.

Upper end of Portage.	6 57 7 2 7 12 17 22	28-442 •442 •442 •440 •440 •440	54-0 54-0 53-0 52-0 52-0 51-8	51-7 •389 •391 •391 •391 •391	28-389 •389 •391 •391 •391 •391	29-472 •389 •391 •391 •391 •391	47-5 •389 •391 •391 •391 •391	47-5 •389 •391 •391 •391 •391	•	•
Savannah P. . .	6 12 30 P.M. 1 0 1 30 2 0	28-569 •578 •578 •572	56-0 57-0 57-4 58-0	51-7 •389 •391 •391 •391	28-390 •389 •391 •391 •391	29-472 •389 •391 •391 •391	47-5 •389 •391 •391 •391	47-5 •389 •391 •391 •391	•	•
R. de Savanna .	7 9 0 30 3 30 A.M.	28-526 •518 •517	34-0 32-1 28-0	33-6 33-5 28-5	28-501 •496 •485	29-733 •733 •816	43-7 43-7 35-8	43-7 43-7 35-8	•	•
L. of the 1000 Islands . . .	8 30 10 9 20	28-571 •561 •561	49-8 49-0 49-5	48-0 •504 •504	28-513 •504 •504	29-869 •890 •890	52-7 54-4 54-4	52-7 54-4 54-4	•	•
Ridge L. . . .	7 0 A.M. 35	28-312 •302	51-0 49-5	48-0 44-0	28-507 •240	29-883 •240	52-9 53-2	52-9 53-2	•	•
French Port. . .	12 30 P.M. 1 0 1 30 2 0 2 30	28-402 •384 •403 •403 •395	55-0 54-0 55-0 54-8 53-5	53-0 53-8 53-6	28-331 •330 •332 •332 •322	29-671 •659 •659 •625	51-9 53-6 53-8	51-9 53-6 53-8	•	•
				55-5	28-329	29-648	53-1	53-1	55	55

The Savannah portage forms the height of land separating the streams which flow into the St. Lawrence from those which fall into Hudson's Bay by Lake Winnipeg.

This excessive difference of level appears due to the opposite states of the atmosphere at the two stations. The barometer at Toronto is considerably above the mean, and that at Ridge Lake below the mean.



2nd P. out of L. à la Crosse.	11	8 0 P.M.	28.672	57.5	50.0	28.599	29.445	49.0	
		9 0	.655	53.6	50.0	.590	.450	48.5	
		9 0 A.M.	.706	69.8	67.2	.601	.558	53.8	
		10 0	.717	70.5	68.0	.609			
		3 0 P.M.	.657	70.0	56.0	.541	.583	58.2	
		4 0	.668	65.0	54.0	.580			
					57.6	28.587	29.529	53.6	894 1236
Pge. into L. la Pluie.	12	2 15 P.M.	28.525	63.8	66.0	28.433	29.639	73.5	
		30	.523	64.0		.431			
		45	.515	64.0		.423	.612	73.7	
					66.0	28.429	29.626	73.6	1174 1516
L. la Pluie . .	13	9 0 A.M.	28.486	52.6	52.0	28.432	29.298	59.0	
		30	.500	52.0	51.5	.437	2		
		10 0	.515	52.0	51.3	.452	29.277	60.2	
		30	.520	52.0	51.6	.457			
		11 0	.532	52.4	51.5	.469	29.255	61.8	
		30	.544	53.5	51.5	.478			
		1 15	.569	56.0	55.7	.498	29.226	64.9	
		3 0	.580	57.5	55.9	.505	.180		
					52.6	28.466	29.259	61.4	760 1102 7
L. la Pluie . .	14	7 0	28.639	51.0	48.0	28.580	29.172	60.2	
		8 0	.639	49.5	48.0	.580	.198	59.5	
		9 0	.650	48.4	47.6	.596	.195	57.2	
		3 0 A.M.	.707	46.0	43.1	.652	.174	52.3	
					46.2	28.602	29.185	57.3	707 1049 14

Barometric Observations.—*continued.* All with No. 119.

STATION.	DATE. June, 1843.	Barometer.			Barometer Corrected and Reduced.	At Toronto.		Elevated above Toronto, The Sea.		Correction.
		Observed.	Merc.	Air.		Barometer.	Air.	Toronto.	The Sea.	
Fort Frances . .	15	H. M.								
		9 0 A.M.								
		30	59.0	46.0	28.643	29.625	50.6			
			57.0		.643	.625	50.6			
			55.2		.655	.625	53.6			
			55.0		.657	.616	55.0			
			58.0		.666	.616	55.0			
			62.0	47.0	.676	.596	57.6			
					28.657	29.617	53.7	898	1230	20

*Observations made during the Voyage of 1843.*

THE barometers were suspended whenever a halt of sufficient duration was made; and the difference of elevation of each station above the Observatory at Toronto has been calculated by employing the nearest hourly observations made there, or sometimes the mean between two consecutive readings, as a corresponding observation. This method appeared preferable to that of reducing each observation to the mean barometric pressure at the level of the sea, although it is evident, on a comparison with the meteorological journal at Toronto, that, in some cases, very different states of the weather prevailed in the two localities. The elevation above the sea is found by adding the approximate elevation of the observatory, viz. 432 feet, to each difference of level. As a further correction, although in most instances insignificant, the approximate height of the cistern of the barometer above the water-level is entered in an adjoining column.

The mean height of the barometer at Toronto is 29.620 inches.

On referring to the observations on Lake Huron, it appears that the extremes of the differences of level by six comparisons, differ to the amount of 51 feet. The mean of the whole gives an elevation of 551 feet above the sea, being 55 feet less than that deduced by the observations of 1841 and 3 (antè), and 43 feet less than the elevation assigned on the maps of the Useful Knowledge Society. The greatest difference occurs on the 16th of May, when a violent westerly gale prevailed on Lake Huron, during which the barometer rose, between 1 and 6 p.m. at that station, 0.144 inch. While at Toronto, where the same gale prevailed to a much less degree, it rose only 0.092 inch during the same period. The barometer, therefore, was relatively higher at Lake Huron than at Toronto, and the difference of elevation is too small. The distance between the stations is about 300 miles. If we omit this comparison, the mean elevation is 560 feet, which is 45 feet less than the elevation found before. The extremes of the remaining five observations, however, differ to the amount of about 22 feet only.

On Lake Superior, at which from its greater distance from Toronto, and its different local influences, a less degree of correspondence in atmospheric condition might be anticipated than we should expect on Lake Huron, the discordances in the resulting differences of level are much greater, amounting to 288 feet in 12 observations. The barometric range observed in the 8 days of comparison was 0.826 on Lake Superior, and 0.611 at Toronto. The range of the barometer is generally below the mean at both stations during this period, the weather having been wet and un-



settled for several days, but to a much greater degree on Lake Superior than at Toronto; the minimum pressure occurs on the same day (22nd of May) in both localities; but between this minimum and the last day of observation (the 26th of May), the barometer rises 0·297 at Toronto, and only 0·110 on Lake Superior; hence it was relatively lower at the latter station, and the mean elevations deduced from the observations of the last three days is decidedly too great. It is 769 feet; the remaining 9 comparisons giving a mean of 643 feet. This quantity is 16 feet more than the received elevation, and makes Lake Superior 83 feet above Lake Huron instead of 33 feet, which is the difference of level shown by the same authority.

On referring to the observations taken along the route from Lake Superior to Lake la Pluie, they exhibit a tolerably regular progression, indicating an ascent from the above elevation of about 650 feet to an elevation of about 1500 feet, at which are found the principal sources of the waters that flow, in opposite directions, into the St. Lawrence and into Lake Winnipeg. The discordances indicate an uncertainty in individual observations of from 100 to 200 feet.

The barometer was unfortunately broken on the River la Pluie, and the series there terminates.

---

*On Thermometric Measurements of Heights in the Hudson's Bay Territory.*

THE following tables contain the observations of the temperature of boiling water made at various stations, and a comparison, at some of them, of the elevations deduced with the elevation resulting from the foregoing barometric observations. The data employed for the computation are those given by Lieut.-Colonel Sykes, Trans. of Royal Geogr. Soc., Vol. VIII.

One thermometer only, marked M, was employed from Lake Superior to Hudson's Bay. It was graduated at a pressure of 29·450 inches, as marked on it by the maker, which would make the boiling point at the mean pressure of 29·980 inches, to be 212°·91, instead of 212°·00, if we allow a difference of  $-1^{\circ}\cdot0$  in the boiling point for  $-0\cdot58$  inch of pressure. It was boiled again on the 25-6th July, 1843, at York Factory in Hudson's Bay, when the boiling point was found to be 213°·37, the pressure being unknown; and it was boiled at Toronto, after its return from the North, but not until the lapse of a year, viz., in December, 1845. The Tables I. and II. exhibit the result of several observations made at Toronto under various circumstances of atmospheric pressure and temperature.

Each observed boiling point is reduced to a mean pressure of  $29^{\circ}620$  on the assumption of a difference of  $\pm 1^{\circ}0$  in the boils point, for a difference of  $\pm 0.58$  inch in the pressure. The elevation of the Observatory above the ocean is 432 feet nearly, and if we allow a difference of  $1^{\circ}0$  for 509 feet of elevation, the correction to reduce the observations to the zero plane, or level of the ocean, will be  $\pm 0^{\circ}67$ .

Abstract of Observations of the Boiling Point at Toronto.

TABLE I.

DATE.	Barometer Corrected.	Air.	Observations on Boiling Point.	Correction +	Reduced to mean Pressure.	Reduced to Zero Plane.
1845.						
Dec. 1	29.563	21.4	213.33	.10	213.43	
„ 10	.614	15.9	13.33	.01	13.34	
„ 12	30.184	19.4	14.50	— .97	13.53	
„ 13	.009	28.8	14.25	— .67	13.58	
„ 15	29.519	33.3	13.28	.17	13.45	
	29.778	23.7	13.74		213.47	214.14
„ 16	29.672	27.0	213.60	— .09	213.51	
„ 47	.610	32.3	13.36	.02	13.38	
„ 18	.400	33.6	13.18	.38	13.56	
„ 19	.372	11.0	13.01	.43	13.44	
„ 20	.716	10.3	13.88	— .12	13.76	
	29.554	23.7	213.41		213.53	214.20
„ 22	29.607	12.4	213.69	.02	213.67	
„ 23	.872	17.7	14.37	— .44	13.93	
„ 24	.986	19.4	14.46	— .63	13.83	
„ 26	30.018	15.0	14.84	— .69	14.15*	
„ 29	29.427	34.4	13.10	.33	13.43	
„ 30	.615	27.9	13.69	.01	13.70	
	29.754	21.1	214.03		213.71	214.38
„ 31	30.008	11.6	214.54	— .67	213.87	
Jan. 1846 1	29.638	31.2	13.70	— .05	13.65	
„ 2	28.872	37.6	11.97	1.29	13.26	
„ 3	29.443	31.6	13.50	.30	13.80	
„ 5	.748	29.9	14.02	— .22	13.80	
„ 6	30.032	31.8	14.51	— .71	13.80	
	29.623	28.9	213.71		213.70	214.37

\* The observation on the 26th December is rejected: it was considerably in excess of the others, and possibly there may have been a break in the column of mercury, which escaped notice.

The barometric range at Toronto is 1.65 inch, by an average of five years (1839 to 1844) equivalent to  $2^{\circ}85$  in the boiling point, or to the effect of a difference of elevation of 1400 feet. The above table contains a range of  $1^{\circ}31$  inch, and the same observations are arranged in the following Table II., in the order of pressure, for the purpose of illustrating the correspondence of Pressure and Boiling Point.

TABLE II.

DATE.	Barometer Corrected.	Air.	Observations on Boiling Point.	Correction +	Reduced to mean Pressure.	Reduced to Zero Plane.
1845-6.						
January 2	28·872	37 <sup>o</sup> ·6	211 <sup>o</sup> ·97	1·29	213 <sup>o</sup> ·27	
Dec. 19	29·372	11·0	13·01	0·43	13·44	
„ 18	·400	33·6	13·18	·38	13·56	
„ 29	·427	34·4	13·10	·33	13·43	
January 3	·443	31·6	13·50	·30	13·80	
	29·303	29·6	212·95		213·49	214·15
Dec. 15	29·519	33·3	213·28	·17	213·45	
„ 1	·563	21·4	13·33	·10	13·43	
„ 22	·607	12·4	13·19	·02	13·67	
„ 17	·610	32·3	13·36	·02	13·38	
„ 10	·614	15·9	13·33	·01	13·34	
	29·583	23·1	213·40		213·45	214·12
„ 30	29·615	27·9	213·69	·01	213·70	
Jan. 1	·638	31·2	13·70	—·05	13·65	
Dec. 16	·672	27·0	13·60	·09	13·51	
„ 20	·716	10·3	13·88	·12	13·76	
Jan. 5	·748	29·9	14·02	·22	13·80	
Dec. 23	·872	17·7	14·37	·44	13·93	
	29·710	24·0	213·88		213·72	214·39
Dec. 24	29·986	19·4	214·46	·63	213·83	
„ 31	30·008	11·6	14·54	·67	13·87	
„ 13	·009	28·8	14·25	·67	13·58	
„ 26	·018	15·0	14·84	—·69	14·15	
Jan. 6	·032	31·8	14·51	·71	13·80	
Dec. 12	·184	19·4	14·50	·97	13·53	
	30·044	22·2	214·45		213·72	214·39

The thermometer was boiled in a copper vessel, in snow water, care being taken to allow a full escape to the steam through holes in the covering.

Taking the mean of the first ten observations in Table I., viz., 214<sup>o</sup>·17 for the boiling point at the level of the sea, we have the following determinations:—

By the maker, date unknown . . . 212<sup>o</sup>·91 at bar. 29<sup>o</sup>·980  
 At York Factory, July, 1843 . . . 213·57 „, unknown.  
 At Toronto, Dec. 1845 . . . 214·17 „, 29<sup>o</sup>·980

Clearly indicating a rise in the zero of the thermometer similar to what has been frequently remarked in the zeros of air thermometers (British Assoc. Report, 1840, p. 46), and the same circumstance appears in the series of observations made at Toronto, where the mean of the last five days exhibits a rise of a quarter of a degree (0<sup>o</sup>·24) above that of the first five days.

It is evident from Table II., that for the determination of moderate elevations, such as those of the great fresh-water basins, and dividing ridges or heights of land, in the interior of the North American continent, but little confidence can be placed in any individual results. Observations, to be of value, must be repeated in every variety of weather and of atmospheric condition. The barometric range at Toronto is nearly equal to the whole difference of pressure corresponding to the elevation of the great height of land which forms the northern boundary of the valley of the Missouri, and which divides the streams which flow into that river and the St. Lawrence from those which fall into Hudson's Bay. Nor is anything gained by a multiplication of thermometers. The effect of uncertainty in the observation, or the zero, is inconsiderable compared with that which arises from uncertainty in the barometric pressure. Neither, again, is there much advantage in corresponding observations of the barometer, unless the mean barometric pressure on the spot is known, or comparative observations are made at a known station not very distant. At the present time the mean pressure is not known at any spot north of Lake Superior.

From the great difficulty attending the safe transportation of barometers in long journeys in the interior, the use of thermometers is much more convenient to travellers; and, in 1836, several of these instruments were sent into the country by the Royal Geographical Society, at the instance of Sir John Richardson, two of which were employed by the writer, together with the thermometer M described above. As they were broken before reaching Canada, no opportunity was afforded of verifying their boiling points.

The general elevation of a region is, however, a physical fact of so much importance, as modifying the circumstances of production and climate depending upon its geographical position, and with reference to the great normal plane of the ocean, of so much interest in a geological point of view, that imperfect observations in a country where so few have been made may not be without interest. Those made on the magnetic survey are scarcely numerous enough to give the mean temperature of the boiling point in the districts in which they were made; but they are generally accompanied by a slight notice of the weather, as a guide to the probable *sign*, either + or —, of the *error* in the height deduced.

The atmospheric pressure at Toronto is liable, as has been stated, to an extreme variation of 1.65 inch. In order, however, to obtain an approximation to the probable difference of any single observation from the mean, the "probable error" has been

calculated for the hours of 9 A.M. and 3 P.M. of the months of December, 1843, and July, 1844, by the formula,

$$E^2 = \frac{0.4549 : \Sigma (x - a)^2}{n (n - 1)}$$

Where  $\Sigma (x - a)^2$  = the sum of the squares of the quantities found by subtracting the mean pressure for the month ( $a$ ) at each of these hours, from the readings at the same hour on successive days ( $x$ ). The probable error of each separate reading is  $= E \sqrt{n}$ , and has the following values:—

	Inch.	
December, 9 A.M. .	0.147 = 75 feet of elevation.	
,, 3 P.M. .	0.141 = 75	,,
July, 9 A.M. .	0.105 = 53	,,
,, 3 P.M. .	0.091 = 46	,,

The value of the difference in pressure is here given in feet of elevation, and it appears that fluctuations in the barometric pressure cause a probable error of about 60 feet in any single altitude deduced from the temperature of boiling water at Toronto; the *possible* error, or the greatest error which can arise under extremes of pressure being about 700 feet. The probable error deduced from the series in Tables I. and II., which exhibits a range of barometric pressure somewhat greater than usual in the same number of observations, is 0.206 inch, equivalent to 105 feet.

In the travelling observations of the boiling point, the water of the nearest lake or river was always employed, usually containing calcareous matter, which gradually formed a thin deposit on the bulb and scale of the thermometer. It appeared, however, by observation at Toronto, that the presence of this coating made no sensible difference in the boiling point, nor did it appear to make a sensible difference whether snow water or hard water were employed.

Neglecting the value of the boiling point at the mean pressure, deduced from the graduation by the maker, of which the date is unknown, it is assumed in the following calculations, that the observation at York Factory gave the boiling point at the level of the sea, at that date; and the rise of 0°.80 indicated by the subsequent observations at Toronto took place while the instrument was in use, viz., from July, 1843, to October, 1844, which allows a rise of + 0°.054 a month, and the observed boiling points have been corrected accordingly.

The other thermometers N and O, which were obtained at York Factory and Norway House, were also boiled at the level

of the ocean, at the former stations for comparison with thermometer M. The observed boiling points were—

	M	N	O	Air.
	°	°	°	
July 25th . . .	213·23	212·06	211·65	50°
„ 26th . . .	213·51	212·36	211·79	50°
	213·37	212·21	211·72	

The thermometer marked N continued in use until May, 1844, when it was found to be broken, and the thermometer O until October, 1844, when it was also broken.

The following Table III. contains the differences in the boiling points observed with the three instruments, and serves to show whether the zero correction of N and O underwent a gradual change similar to that of N.

TABLE III.

DATE.	M-N	M-O	N-O	DATE.	M-N	M-O	N-O	DATE.	M-N	DATE.	M-N
1843.				1843.				1844.		1844.	
July 25	1°17	1°58	0°41	Oct. 2	1°14	1°51	0°37	May 4	1°02	Aug. 3	1°10
„ 26	1°15	1°72	0°57	Nov. 1	1°21	1°43	0°22	„ 26	1°15	„ 6	1°00
Aug. 5	1°06	1°41	0°35	„ 10	1°04	1°23	0°19	„ 30	1°05	„ 12	1°21
„ 13	1°04	1°51	0°47	Dec. 2	1°05	1°29	0°24	June 2	1°10	„ 14	1°25
„ 24	0°96	1°50	0°54	1844.				„ 8	0°98	„ 19	1°16
„ 29	„	„	„	Jan. 4	1°03	1°42	0°39	„ 15	0°81	„ 30	0°97
Sept. 9	0°99	1°50	0°51	Feb. 2	1°07	1°36	0°29	„ 21	1°13	Sept. 12	1°08
„ 13	1°15	1°47	0°32	Mar. 4	1°19	1°43	0°24	„ 24	1°21	„ 14	1°10
„ 16	1°08	1°45	0°37	„ 13	1°24	1°45	0°21	July 2	1°30	„ 16	1°14
bis 16	0°97	1°41	0°44	„ 18	1°00	1°25	0°24	„ 26	1°01	Oct. 7	1°33
„ 17	1°03	1°51	0°48	April 3	1°06	1°33	0°27	„ 30	1°10	„ 14	1°16
								Aug. 1	1°09	„ 17	1°20
	1°30	5°05	4°46		11°03	13°70	2°66		12°95		13°70
	1°03	1°50	0°45		1°10	1°37	0°26		1°07		1°14

The difference between thermometers M and N increases to a slight amount, indicating that the zero of M rose more rapidly than that of N. The difference between M and O diminishes, as does that between N and O, both circumstances indicating that the zero of O rose more rapidly than that of either of the others. As, however, the greatest variation in the relative zero correction is but  $0^{\circ}\cdot45 - 0^{\circ}\cdot26 = 0^{\circ}\cdot19$ , which is insignificant compared with uncertainty arising from the difference of pressure, the same uniform rate of increase has been allowed for all, and the true boiling point for each observation is obtained by applying the correction

$$(1^{\circ}\cdot37 + 0^{\circ}\cdot054, n.)$$

to the observed boiling point, after correcting N and O to the standard, by applying the mean differences of M — O, for each

of the periods in the above table;  $n$  is the interval in months from the 26th July, 1843.

TABLE IV.

Observations of the Boiling Point made at Barometric Stations.

DATE.	STATION.	Temp. of Air.	Boiling Point.		Elevation.		Bar.	Bar.	WEATHER.
			Obs.	Corr.	Obs.	Corr.	Corr.	Elev.	
1843.		°	°	°	Feet.	Feet.	°	Feet.	
June 2	Mountain Portage, the lower end	42	212.41	211.04	488	496	29.161	851	Raining.
" 3	Large Flagstones	54	211.51	210.14	945	985	28.807	995	Clear and fine.
" 5	Jordan's Post...	47	211.29	209.92	930	1016	28.628	1115	Fine.
" "	Prairie Portage	55	211.29	209.92	980	1027	28.390	1361	Fine.
" 6	Savannah Portage .....	57	211.48	210.11	965	1015	28.501	1402	High W.N.W. wind. Unsettled.
" 13	L. la Pluie .....	52	211.38	210.01	1016	1059	28.602	1049	Unsettled and stormy.
" 15	Ditto at Fort Frances .....	59	211.51	210.14	950	1004	28.657	1230	Decidedly wet.

The Mountain Portage is the first arrived at after leaving Lake Superior. The barometric elevation deduced for it, which is 224 feet above that of Lake Superior, is probably too great, but that deduced from the temperature of boiling water is probably 150 or 200 feet too little. The thermometer was not supported above the bottom of the vessel until the observation at the Savannah Portage.

The next Table V. contains the observations made with three thermometers, boiled at the same time in a vessel arranged to contain them. The series commences at York Factory, where I obtained the thermometer marked O by the favour of Mr. Hargrave, the gentleman in charge of that establishment. For the other, marked N, I was indebted to Mr. D. Ross, the gentleman in charge of the establishment at Norway House. Both instruments, as has been stated above, were sent out by the Geographical Society, to be used by the officers of the Hudson's Bay Company in their extensive journeys over the interior of the North American continent.

TABLE V.

DATE.	STATION.	Air.	Therms. Observed.				Therms. Observed.				Mean.	Elevation.		WEATHER.
			M.	N.	O.		M.	N.	O.			Obs.	Cor.	
1843.														
July 25	York Factory . . . .	50	213-23	212-06	211-65									Fine; a brilliant aurora.
" 26	" " " " " "	50	213-51	212-36	211-79									Wet, dull.
Aug. 5	Painted Stone . . . .	66	212-66	211-60	211-25		211-29	211-26	211-38		211-31	352	378	Dull, unsettled.
" 13	L. Winnipeg . . . .	67	212-61	211-57	211-10		211-21	211-23	211-23		211-23	403	433	Continued wet.
" 24	Cumberland House . .	58	212-06	211-10	210-56		210-64	210-71	210-64		210-66	682	708	Fresh S. Easterly; fine, but
" 29	Frog Portage . . . .	58	211-18	210-25	210-04		209-76	209-89	210-12		209-92	1006	1057	variable.
" 30	" " " " " "	70	211-98	211-03	..		209-90	210-10	..		210-00	1021	1102	Very fine.
Sept. 9	Isle à la Crasse . . . .	50	211-32	210-33	209-82		209-87	209-91	209-87		209-88	1081	1121	Dull, wind and rain.
" 13	Buffalo . . . . .	58	210-83	209-68	209-36		209-38	209-26	209-41		209-35	1352	1425	
" 16	Methy Portage: . . . .													
" 17	S. end " " " " " "	48	210-17	209-09	208-72		208-71	208-66	208-76		208-71	1647	1702	Dull, showery.
" 17	N. end " " " " " "	36	211-72	210-75	210-31		210-26	210-32	210-35		210-31	861	868	Improved.
Oct. 2	Ditto " " " " " "	32	211-99	210-96	210-48		210-53	210-53	210-52		210-53	749	749	Set, fine.
Nov. 1	Athabasca . . . . .	43	212-54	211-40	211-03		211-05	211-01	211-01		211-02	498	511	Clear and fine.
" 10	" " " " " "	23	212-87	211-66	211-44		211-33	211-22	211-27		211-27	372	364	Overcast, easterly wind.
Dec. 2	" " " " " "	12	213-00	211-96	211-77		211-44	211-50	211-54		211-49	260	247	Clear and fine.
	" " " " " "	8	212-41	211-36	211-12		210-81	210-86	210-89		210-85	586	555	High wind, W.N.W.
1844.														
Jan. 4	" " " " " "	-1	213-51	212-48	212-09		211-86	211-93	211-85		211-88	*60	*54	Slight snow.
Feb. 2	" " " " " "	5	212-96	211-89	211-60		211-25	211-28	211-26		211-26	377	353	Wind light, N. by E.; over-
Mar. 4	" " " " " "	-10	213-57	212-38	212-14		211-81	211-72	211-75		211-76	*122	105	cast.
July 2	" " " " " "	69	212-59	211-29	..		216-61	210-50	..		210-56	733	789	Fine, S.W. wind.
												471	468	{ or 371 ft., if the observations marked thus * are included.





Aug. 12	Fort Assiniboine . . .	54	210·24	209·03	..	208·19	208·13	..	208·16	1921	2009	Fine, followed by much rain.
" 14	Pembina River . . .	55	209·77	208·52	..	207·72	207·62	..	207·67	2216	2322	Dull and unsettled.
" 19	Edmonton . . .	65	210·73	209·57	..	208·67	208·66	..	208·66	1716	1834	Wind, light W.; unsettled.
" *13	Lake Winnipeg (See above)	67	212·61	211·57	..	211·21	211·23	..	211·22	403	433	Wet, dull.
1844.		..	0=	211·10	..	0=	211·23	..				
Sept. 12	"	52	212·34	211·26	..	210·23	210·30	..	210·26	886	923	High N.W. wind; dull, following continued wet.
" 14	"	58	212·43	211·33	..	210·32	210·37	..	210·35	840	865	Moderate S.E.; changeable, but improving.
" 16	"	62	212·49	211·35	..	210·38	210·39	..	210·38	825	870	High S., very fine.
1843.											773	
June 6	Savannah Port . . .	57	211·48	..	..	210·11	..	..	210·11	965	1015	High W.N.W.; unsettled.
1844.												
Oct. 7	"	26	211·50	210·17	..	209·34	209·26	..	209·30	1378	1359	Fine, calm, and unclouded.
June 6	By barometer . . .	..	..	..	..	..	..	..	..	..	1402	
											1259	
Oct. 14	L. Superior . . .	46	212·90	211·74	..	210·74	210·73	..	210·74	639	457	Wind S.; fine but overcast.
" 17	"	32	213·43	212·23	..	211·27	211·22	..	211·25	496	496	Wind W., fresh, and snowing.
											576	

\* 23? (Ed.)

The foregoing observations assign to Lake Winnipeg an elevation of 700 feet above the ocean, if we include with those of 1844 a single day's observation in 1843, but if that observation is omitted, an elevation of 886 feet. The Painted Stone Portage is at the head of a sluggish stream falling into that lake, and at the summit of a secondary ridge, or height of land, which divides the minor streams falling into Lake Winnipeg from those which fall directly into Hudson's Bay. Its elevation, then, must be somewhat greater than that of the lake, and the value deduced from the single observation made there, from 400 to 500 feet too low. The elevation of the Saskatchewan at Cumberland House, by the mean of two observations, is 905 feet, which is quite accordant with the observations on Lake Winnipeg, and supports the general conclusion that the elevation of the latter is about 800 feet.

The next important point is the Frog Portage. The bed of the Churchill or English River at this place is much higher than that of the parallel bed of the Saskatchewan, and in seasons of high water it discharges a part of its redundant burden into the chain of small lakes which communicates with the latter river. The observation makes it 97 feet above Cumberland House, taking for the latter the mean of two observations there. It is probable, from the state of the weather at the time of observation, that the barometric pressure was below the mean; it was extremely wet, mists and decided rain alternately for several days.

The observations at Isle à la Crosse and Buffalo Lake, which latter is very little above the former, assign an elevation of from 1200 to 1300 feet to that part of the bed of the English River. We then come to the celebrated Methy Portage, or Portage de la Loche, at which the traveller first reaches the streams which flow into the Northern Ocean, and which forms the northernmost portion of the great dividing ridges of the continent. Lieut. Hood, in Sir John Franklin's Journal, vol. i. p. 190, calculated the elevation of the hills of the northern end of this portage to be 2467 feet above the ocean, allowing 1 foot per mile to the course of the rivers, and 6 feet to each fall or rapid. The observations made on the spot, those at Isle à la Crosse, and those, to be noticed hereafter, made towards the head of the Athabasca River, concur in giving a considerably less elevation to this region. The elevation of the S. end of the portage, by observation, is 1702 feet; it appears probable that it is rather above than below the truth, from the state of the weather at the time, which was such as is usually accompanied by a barometer below the mean. The land, although generally of a level character, appears to rise towards the other end; if we allow 150 feet for this rise, we have an elevation at the hills at the northern end of 1852 feet. Two observations give a mean elevation of 808 feet to the Clearwater River

at their foot, thus making their elevation above the Clearwater valley 1044 feet.

Lieut. Hood estimates their height at 900 feet. Sir Alexander M'Kenzie (p. xxxvi) remarks that "the precipice at the N. end rises upwards of 1000 feet above the plain beneath;" but if the observation at the S. end gives an elevation above the truth, it appears equally probable, from the very decided improvement in the weather which took place on the 17th of September, that the second observation at the foot of the hills was under circumstances of barometric pressure above the mean, and gives too low an elevation. If, then, we add 150 feet to the first observation for the gradual rise in a distance of 12 miles, and add 950 feet to each of the observations at the foot of the hills, the whole give a mean elevation of 1790 feet to the hills at the northern end, which I believe to be near the truth.

We next come to Lake Athabasca. The boiling point of water was observed here once a month for eight months. It should have been observed at least once a week, and probably a daily observation would have abundantly repaid the time devoted to it; but the writer never having at that time entered into the details of any extensive series of observations of this nature, or met with any instructions on the subject, was not duly impressed with this truth, and would frankly acknowledge his oversight in this place for the benefit of any future travellers who may be placed in the same circumstances. It appears from Table I. that the mean of 21 observations at Toronto, made under a great variety of atmospheric circumstances, and differing (between the extremes)  $2^{\circ} \cdot 57$  in the boiling points observed, is  $18'$  too high; being  $213^{\circ} \cdot 68$  instead of  $213^{\circ} \cdot 50$ , by thermometer M, which latter is the true mean corresponding to the mean pressure. The barometric range in these observations, as remarked above, was  $1 \cdot 3$  inches, and it is probable that at least an equal number of observations will be generally requisite, in the winter season in countries without the tropics, to determine the elevation of a region with any approach to precision. Referring to the eight months' observations recorded at Athabasca, it appears that they give a mean elevation of 371 feet to that lake, or, if we reject two results most palpably below the truth, of 468 feet. The latter value indicating a fall of 340 feet in the beds of the Clearwater and Athabasca Rivers from the foot of the Portage de la Loche, appears to be greater than the distance and nature of the current renders probable; although the numerous rapids and falls on the Clearwater River indicate a rapid declivity, while it is also less than the distance of Lake Athabasca from the ocean, and the rapidity of the current in the Slave and Mackenzie's Rivers. Lake Athabasca, to the course of its discharging waters,

is about 1400 miles distant from the Northern Ocean, and the writer considers this elevation, as well as that for Great Slave Lake, to be considerably under the truth.

The four observations at Fort Simpson, on Mackenzie's River, are too irregular to warrant any conclusion from them.

The next series of observations was made in the elevated region at the base of the Rocky Mountains, between Peace River and the Saskatchewan, a district remarkable for its gradual and regular ascent, preserving throughout, much of the character of a plain country. From Lake Athabasca to Dunvegan, a distance of about 650 miles, there occurs but one inconsiderable fall and a few rapids; the bed of the Peace River preserves nearly a uniform inclination, in which it rises, by the observations here given, 310 feet (778—468 feet). The stream is, however, more rapid above Fort Vermilion than below it. The depth of the bed of the stream below the surrounding country increases with great uniformity as we ascend the river. A defile, very similar to that called the Ramparts on Mackenzie's River, but on a finer scale and with far more picturesque features, occurs about 8 miles above the River Cadotte, in long.  $117^{\circ}$ , and here the river has cut a passage through cliffs of alternating sandstone and limestone to the bed of shale, through which it flows at a depth of 200 feet (by estimation) below their summit. The general elevation of the country, however, still continues to increase, and at Dunvegan it is 600 feet above the bed of the stream; yet even at this point, except on approaching the deep gorges through which the tributaries of Peace River join its waters, there is little indication of an elevated country; the Rocky Mountains are not visible, and no range of hills meets the eye.

A rough trigonometrical measurement gave 538 feet as the elevation of the Gros Cap, a bold hill behind Fort Dunvegan, above the bed of the river. The ground was estimated to rise behind the Gros Cap, by a gradual ascent, about 100 feet, until it attains the general level. The observation of the boiling point at Dunvegan, compared with that taken four days later on the route to Lesser Slave Lake, shows a difference of level of 575 feet; but both these observations are considered as giving an absolute elevation below its probable amount. The Lac Puant or Stinking Lake has no communication with Lesser Slave Lake, and must be very nearly on the same level; their distance apart is but 35 miles of level country; it is, therefore, included in a group with the latter, and the observations give an elevation of 1838 feet to this region. The observation on the 30th of July was made on the plains half a day W. of the Rivière qui Barre, and as it is uncertain whether the difference of the boiling point is due to difference of atmospheric circumstances or to difference of level, it is

not included with them. The nature of the rise from Lesser Slave Lake to Fort Assiniboine can hardly perhaps be inferred from the great velocity of the current in the Assiniboine River which prevailed at the time of the writer's ascent, the waters being then swollen several feet above their ordinary level; yet it must be considerable, and it is probable that the difference of 171 feet, shown by comparing the mean of the last group with the observation at the fort, is not much in excess. The elevation given for the line of country from thence to Edmonton is about 2055 feet. This value has to be viewed in relation to the elevation of Lakes Winnipeg and Athabasca, into which the rivers on the opposite side of the district flow, and if we allow that the elevation of Lake Athabasca, 468 feet, is too low, and that that of the Clearwater River is more nearly correct, it is consistent with the other determinations. The rapidity of the bed of the Assiniboine above the point at which the Clearwater enters it, is known to be extremely great, while it is at the same time so much interrupted by falls and rapids as to be scarcely navigable; the data require a fall of 1200 feet in a course of about 500 miles, which is less in proportion than that of Nelson River from Lake Winnipeg to the sea, if the elevation of 850 feet assigned to that lake be not too great. The observation at the Savannah Portage, in 1844, gives an elevation 244 feet greater than that found in 1843, and more nearly approaching the barometric difference of level. The mean of the whole is 1259 feet for this height of land, which, taken in connexion with the barometric elevations found for stations on either side, appears to be too low.

Reviewing the whole body of observations, and taking all the stations as mutually checking each other, through the known relations of elevation indicated by the course of the rivers, I should assign, from their general testimony, the following elevations for the principal points embraced in the series.

	Elevation.	
	Observed.	Assigned.
The Savannah Portage, or height of land between Lake Superior and Lake Winnipeg . . . . .	1259	1450
The Lake la Pluie . . . . .	1160	1160
Lake Winnipeg . . . . .	773	853
The Frog Portage . . . . .	1057	1100
Lake of Isle à la Crosse . . . . .	1273	1300
The S. end of the Portage de la Loche . . . . .	1702	1540
The N. end of " " . . . . .	—	1790
The foot of the hills at " " . . . . .	808	840
Lake Athabasca . . . . .	371	600
Great Slave Lake . . . . .	315	500
Lesser Slave Lake . . . . .	1838	1800

	Elevation.	
	Observed.	Assigned.
The country about Edmonton on the Saskatcha- wan . . . . .	1834	1800
The country about Fort Assiniboine . . . . .	2009	2000
„ „ Dunvegan or Peace River . . . . .	1416	1600
The bed of Peace River at Dunvegan . . . . .	778	900

It appears impossible, without some such generalization as the foregoing, to turn a series of observations, liable individually to such large errors, to the best account. Neither can it so well be made as by one possessed of the local knowledge acquired by visiting all the localities, and so far furnished with means of estimating the relative weight of the observations made on them. On this view the above observations are provisionally given. It may be hoped that they will be examined hereafter by other travellers, or by the gentlemen of the Hudson's Bay Company whenever they are provided with the necessary instrumental means. It will be remarked that the difference of elevation between Isle à la Crosse and the S. end of the Methy Portage, which, as observed, is 429 feet, is given as 240 feet; but it cannot be doubted that even this latter is too great a difference. It is not likely that the six portages and the rapids in River la Loche, a distance of about 30 miles, cover a difference of so large an amount; but as each value stands connected with others, and is independently supported by them, the discrepancy is left to be reconciled by future observations.

---

XVI.—*Note on the N.W. Coast of Borneo, from Pulo Laboan to the Entrance of Malulū Bay.* Transmitted to the Royal Geographical Society by W. S. HARVEY, Esq., H.M.S. Agincourt.

PULO LABOAN does not appear to have the coal which was said to exist there; not more than a plateful being scraped up in half an hour. A bed of very fine coal 12 or 13 feet in thickness was found near the mouth of the Bruné River. It has been tried, and pronounced to be well adapted for steamers. The bed is not more than 10 miles from the harbour of Laboan. This harbour is excellent, admitting large ships to lie close in to the shore, and affords a perfect shelter in the N.E. monsoon; the soil is good and the climate healthy: the average height of the thermometer being 74° at noon. This island belongs to Great Britain.